Risk factors associated with hepatitis B and C in rural population of Burera district, Rwanda

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Key words: Hepatitis B virus, hepatitis C virus, Rwanda

Received: 21 Jun 2018 - Accepted: 02 Sep 2019 - Published: 12 Feb 2020

Abstract

Introduction: several studies have shown that older people have a higher risk of exposure to viral hepatitis B and C than younger people. This study aimed to determine the seroprevalence of hepatitis B and C and their associated factors in people aged 45+ years old in Burera, a rural district of Rwanda. Methods: a cross-sectional study was conducted from July to December 2017 during a mass campaign of hepatitis B (HBV) and hepatitis C (HCV) screening and vaccination of eligible populations against HBV in Burera District. Blood samples were collected and hepatitis B surface antigen (HBsAg) and an antibody against hepatitis C (Anti-HCV) were detected using an Enzyme-Linked Immuno-Sorbent Assay (ELISA). The associated factors were identified using a structured questionnaire and the data was analyzed using SPSS software. Results: of the 374 people included in this study, 53.2% were females. The median age was 56 years old with an interquartile range (IQR) of 50 - 63 years old. The prevalence of HBV and HCV infection was 6.4% and 9.4%, respectively, with 0.3% co-infection rate. Age, social economic level, history of blood transfusion, history of never using a condom, as well as a history of injury with a used sharp material were significantly associated with HCV infection. Conclusion: the study showed a high seroprevalence of both HBV and HCV in Burera’s elderly population aged 45+ years. Several factors associated with HBV and HCV in this study could be prevented through education and improved hygiene.

Pan African Medical Journal. 2020;35:43. doi:10.11604/pamj.2020.35.43.16226

This article is available online at: http://www.panafrican-med-journal.com/content/article/35/43/full/

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**Introduction**

Historically, hepatitis has been described as a common cause of jaundice in the young population, which can develop into a chronic condition [1]. The hepatitis B virus (HBV) and hepatitis C virus (HCV) were discovered in the late 20th century as the major causes of hepatitis [2,3]. In their chronic state, apart from being associated with cirrhosis and Hepatocellular Carcinoma (HCC) due to the prolonged immune clearance phase, 3.5% of the world’s population (more than 250 million people) are infected with HBV with about one in five people residing in sub-Saharan Africa (SSA) [4-7] suffering from this disease. Three percent (more than 170 million people) of the world population are infected with HCV with the majority also living in developing countries [3-7]. The transmission of HBV and HCV occur when the virus has been exposed to percutaneous or mucosal membrane. According to Wertheim et al. [8], HBV is more easily transmitted through sexual contact, breast-feeding and transfer of other body fluids (saliva, semen, vaginal secretions, menstrual blood, and tears) of infected individuals rather than HCV. Other risks for infection include blood transfusion, unsafe use of therapeutic injectable drugs, sharing razors, and tattooing [9]. Health care workers (HCW), intravenous drug users (IVDU), patients on hemodialysis, blood product users and people located in high prevalence regions have a higher rate of exposure to both viruses [8]. Published studies describing the burden of these viral infections in the Rwandan population were hospital based [10-17]. One of the recent studies conducted at Rwanda Military Hospital (RMH) showed a high prevalence of active HCV among older patients aged 55+ years [16]. However, risk factors associated with the seroprevalence of hepatitis in the urban and rural districts of Rwanda population are not well understood. This study aimed to determine the factors associated with hepatitis B and C among Burera district’s rural population aged 45+ years.

**Methods**

After obtaining ethical approval from Butaro Hospital Ethical Committee and INES review board, a cross-sectional study was conducted in Burera district from July to December 2017. The study population was comprised of adults (45+ years old) who were selected among the Burera population that attended a mass campaign for screening for hepatitis B and C. Verbal consent was obtained from 374 participants. Participants were then asked to provide socio-demographic information and the information related to the exposure on the risk factors associated with HCV and HBV infections. We drew 4 ml of blood from each participant through venipuncture using a vacutainer and an ethylene-diamine-tetra-acetic acid (EDTA) anticoagulant tube. Blood was centrifuged (Universal 320 R) at 3000 rpm. The obtained plasma was kept at -20°C until the test day. Murex HBsAg (version 3.0) kit, ELx50 Microplate Strip Washer, and ELx800 Absorbance Microplate Reader were used to determine HBsAg for HBV infection confirmation. The cut off value for each plate was calculated following the kit’s insert where 0.05 was added to the mean of the negative control. The HCV was confirmed by the presence of HCV antibody in the participant plasma using the kit of Murex anti-HCV (version 4.0) with a specificity of 99.88%. The cut off value for each plate was calculated by adding 0.6 to the mean of negative control. Both kits were 100% sensitive and the absorbance, which is equal or greater than the cut off value, was considered as positive. Data were organized and entered in SPSS software version 20. Demographic characteristics were presented using frequencies and percentages, Chi-square ($\chi^2$) test was used to assess the factors associated with HBV and HCV infections. A $P$ value of less than 0.05 was considered significant.

**Results**

Of the 374 participants, the median age was 56 years, with an Interquartile range (IQR) of 50 to 63 years, with 53.2% being females and 46.8% being males. Most of the participants were married, working as farmers, with little to no education. The participants in this study were distributed equally across all social economic categories (Table 1). However, 35 of 374 participants (9.4% [95% CI: 6.6-12.8%]) had HCV while, 24 of 374 participants (6.4% [95% CI: 4.1-9.4%]) had HBV. The co-infection rate was 0.3% (95% CI: 0.007, 1.5). Fifteen point two percent (57 of 374) reported having a history of sexually transmitted disease. Only 6.4% (24 of 374) reported having received blood transfusion, which has significant association with HCV ($p$-value of 0.007). Only 4% (15 of 374) had lived with someone infected with either HBV or HCV. Only 0.3% (1 of 374) had received a vaccine against HBV, and none had HIV. As represented in the Table 2, Table 3, people aged between 58 to 68 years were most likely to be HBV positive with 9 of 81 (11.1%) participants in this age group testing positive for HBV. In terms of HCV, high seropositivity was found in the age group of those 68+ years old, with 13 of 66 (18.4%) participants testing HCV positive. Data assessing risk...
infections are hepatocyte specific agents that lead to all 96% of all viral hepatitis-related deaths [2]. Various studies have been conducted to describe and understand the burden of disease and to recommend preventive measures to eradicate infections. In 2015, the HBV and HCV prevalence were between 4.6-8.5% and 0.7-2.4%, respectively in Africa [7]. We found a higher seroprevalence than other studies conducted in Rwanda which might be due to the increased exposure and decreased immunity of the population in the topic. Other studies found the prevalence ranging from 2.4 to 4.5% for HBV and 1.3 to 5.7% for HCV [10,12,14,15,17]. The co-infection rate observed in this study is similar to the coinfection prevalence observed by Umutesi et al. [17]. For the biological sex, many studies have found that females have a higher risk for HBV than males [14,17-19]. But in contrast, in our study population, we found that males might have a higher risk for HBV. Like other studies conducted with the aim of determining HCV infections, hepatitis C infection rate is higher in elderly individuals. The observed findings were similar with a previous study of Umutesi et al. [17] and was in concordance with other studies that showed a high number of HCV positive people amongst the older population [12,16,18]. HBV and HCV are transmitted after the percutaneous or mucosal exposure to infected blood [20]. While two of the typical HBV risk factors (surgical history and blood transfusion history) had p-values only slightly greater than 0.05, the other risk factors were not found to be remotely significant. The scarcity of information on the vertical transmission mode of this virus which has not been studied in Rwanda, remain a point of interests for further investigations. In addition to age, low socioeconomic status was reported as another risk factor for HCV [21]. Developing countries have a historically high prevalence of HCV, which is echoed by the findings of this study. Moreover, in this study, HCV antibody was detected amongst those who engage in unprotected sex and those who had an accidental injury with a used sharp object which is contradictory to many studies [14,16,18]. HBV has been efficiently linked with unprotected sex [22]. However, evidence shows that the relation between HCV and unsafe sexual intercourse is a rare case which is highly reported in men who have sex with men [23]. Despite that perspective, the contradiction observed in the population of Burera suggests that cohort studies could more effectively assess the association between this behavior and infection rates.

### Discussion

Hepatitis B and C viral infections are hepatocyte specific agents that lead to all 96% of all viral hepatitis-related deaths [2]. Various studies have been conducted to describe and understand the burden of disease and to recommend preventive measures to eradicate infections. In 2015, the HBV and HCV prevalence were between 4.6-8.5% and 0.7-2.4%, respectively in Africa [7]. We found a higher seroprevalence than other studies conducted in Rwanda which might be due to the increased exposure and decreased immunity of the population in the topic. Other studies found the prevalence ranging from 2.4 to 4.5% for HBV and 1.3 to 5.7% for HCV [10,12,14,15,17]. The co-infection rate observed in this study is similar to the coinfection prevalence observed by Umutesi et al. [17]. For the biological sex, many studies have found that females have a higher risk for HBV than males [14,17-19]. But in contrast, in our study population, we found that males might have a higher risk for HBV. Like other studies conducted with the aim of determining HCV infections, hepatitis C infection rate is higher in elderly individuals. The observed findings were similar with a previous study of Umutesi et al. [17] and was in concordance with other studies that showed a high number of HCV positive people amongst the older population [12,16,18]. HBV and HCV are transmitted after the percutaneous or mucosal exposure to infected blood [20]. While two of the typical HBV risk factors (surgical history and blood transfusion history) had p-values only slightly greater than 0.05, the other risk factors were not found to be remotely significant. The scarcity of information on the vertical transmission mode of this virus which has not been studied in Rwanda, remain a point of interests for further investigations. In addition to age, low socioeconomic status was reported as another risk factor for HCV [21]. Developing countries have a historically high prevalence of HCV, which is echoed by the findings of this study. Moreover, in this study, HCV antibody was detected amongst those who engage in unprotected sex and those who had an accidental injury with a used sharp object which is contradictory to many studies [14,16,18]. HBV has been efficiently linked with unprotected sex [22]. However, evidence shows that the relation between HCV and unsafe sexual intercourse is a rare case which is highly reported in men who have sex with men [23]. Despite that perspective, the contradiction observed in the population of Burera suggests that cohort studies could more effectively assess the association between this behavior and infection rates.

### Conclusion

We found a high seroprevalence of HBV and HCV infections in Burera citizens aged 45+ years. Despite the fact that HBV and HCV have similar transmission modes, a striking difference in the seroprevalence was observed and only HCV had statistically significant association, including age, social economic level, blood transfusion, lifetime of unsafe sex intercourse and injury with a used sharp/piercing material. This study highlighted the absence of HBV vaccination among the targeted population. Through education and improved hygiene, the identified factors can be prevented. A cohort study is needed to determine the prevalence of HBV and HCV in the general population to better understand associated risk factors.

**What is known about this topic**

- The prevalence of HCV infection in Rwanda increases with age, however HBV infection varies within age, and both are high among older person;
- There are no known risk factors associated with viral hepatitis B in Rwanda.

**What this study adds**

- The prevalence of HBV and HCV is very high in older citizens in Rwanda;
- Blood transfusion, history of never using condom, injury with a used sharp material and social economic level are associated with HCV among older citizens in Rwanda.

### Competing interests

The authors declare no competing interests.
Authors’ contributions

Iradukunda PG and Mpunga T have participated in all phases of this study during proposal preparation, data collection, data analysis and manuscript writing; Habaryimana T and Niyonzima FN contributed in the manuscript revision with an additional of work supervision done by Habaryimana T. Uwitonze AY also reviewed the manuscript. All the authors have read and agreed to the final manuscript.

Tables

Table 1: socio-demographic and socio-economic characteristics of participants
Table 2: socio-demographic and socio-economic characteristics of HBV seropositive among study participants
Table 3: socio-demographic and socio-economic characteristics of anti-HCV positive among participant in the study
Table 4: factors associated with hepatitis B surface antigen seroprevalence
Table 5: factors associated with hepatitis C virus antibody seroprevalence

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| Variables                      | N 373 | %    |
|-------------------------------|-------|------|
| **Gender**                    |       |      |
| Male                          | 175   | 46.8 |
| Female                        | 199   | 53.2 |
| **Age**                       |       |      |
| < 48                          | 55    | 14.7 |
| [48-58]                       | 175   | 46.0 |
| [58-69]                       | 81    | 21.7 |
| 68+                           | 66    | 17.6 |
| **Marital status**            |       |      |
| Single                        | 0     | 0    |
| Married                       | 268   | 71.7 |
| Widowed                       | 93    | 24.9 |
| Divorced                      | 13    | 3.5  |
| **Level of education**        |       |      |
| None                          | 164   | 43.9 |
| Some primary                  | 85    | 22.7 |
| Completed primary             | 80    | 21.4 |
| Some secondary                | 25    | 6.7  |
| Completed secondary           | 15    | 4.0  |
| University or Higher          | 5     | 1.3  |
| **Social economic Level**     |       |      |
| Category 1                    | 126   | 33.8 |
| Category 2                    | 125   | 33.5 |
| Category 3                    | 122   | 32.7 |
| **Occupation**                |       |      |
| Farmer                        | 322   | 86.1 |
| Civil servant                 | 17    | 4.5  |
| Self-Employee                 | 10    | 2.7  |
| NGO employee                  | 6     | 1.6  |
| Other                         | 19    | 5.1  |
| Variable                   | N   | HBsAg+ve (%) | P value |
|----------------------------|-----|--------------|---------|
| Gender distribution        |     |              |         |
| Female                     | 199 | 11 (5.5)     | 0.454   |
| Male                       | 175 | 13 (7.4)     |         |
| Age group (years)          |     |              |         |
| [45-48]                    | 55  | 4 (7.2)      | 0.123   |
| [48-58]                    | 172 | 10 (5.8)     |         |
| [58-68]                    | 81  | 9 (11.1)     |         |
| 68+                        | 66  | 1 (1.5)      |         |
| Marital status             |     |              |         |
| Married                    | 268 | 2 (15.4)     | 0.080   |
| Divorced                   | 13  | 20 (7.5)     |         |
| Widower                    | 93  | 2 (2.2)      |         |
| Social economic category   |     |              |         |
| Category 1                 | 126 | 7 (5.6)      | 0.867   |
| Category 2                 | 125 | 9 (7.2)      |         |
| Category 3                 | 122 | 8 (6.6)      |         |
| Category 4                 | 0   | 0            |         |
| Level of education         |     |              |         |
| None                       | 164 | 9 (5.5)      | 0.419   |
| Some primary               | 85  | 3 (3.5)      |         |
| Primary                    | 80  | 7 (8.8)      |         |
| Some secondary             | 25  | 3 (12)       |         |
| Secondary                  | 15  | 1 (6.7)      |         |
| University or +            | 5   | 1 (20)       |         |
| Occupation                 |     |              |         |
| Farmer                     | 322 | 21 (6.5)     | 0.744   |
| Civil servant              | 17  | 2 (11.8)     |         |
| Self-employee              | 10  | 0 (0)        |         |
| NGO employee               | 6   | 0 (0)        |         |
| Other                      | 19  | 1 (5.3)      |         |

Note: no significant variable at 95% confidence interval (P-value > 0.05).
| Characteristics               | N     | Anti-HCV+ve (%) | P.value |
|------------------------------|-------|-----------------|---------|
| **Gender distribution**      |       |                 |         |
| Female                       | 199   | 22 (11.1)       | 0.23    |
| Male                         | 175   | 13 (7.7)        |         |
| **Age group (years)**        |       |                 |         |
| [45-48]                      | 55    | 2 (3.6)         | 0.003*  |
| [48-58]                      | 172   | 10 (5.8)        |         |
| [58-68]                      | 81    | 10 (12.3)       |         |
| 68+                          | 66    | 13 (19.7)       |         |
| **Marital status**           |       |                 |         |
| Married                      | 268   | 22 (8.2)        | 0.129   |
| Divorced                     | 13    | 0 (0)           |         |
| Widower                      | 93    | 13 (14)         |         |
| **Social economic category** |       |                 |         |
| Category 1                   | 126   | 21 (16.7)       | 0.003*  |
| Category 2                   | 125   | 7 (5.6)         |         |
| Category 3                   | 122   | 7 (5.7)         |         |
| Category 4                   | 0     | 0               |         |
| **Level of education**       |       |                 |         |
| None                         | 164   | 20 (12.2)       | 0.375   |
| Some primary                 | 85    | 6 (7.1)         |         |
| Primary                      | 80    | 8 (10)          |         |
| Some secondary               | 25    | 0               |         |
| Secondary                    | 15    | 1 (6.7)         |         |
| University or +              | 5     | 0               |         |
| **Occupation**               |       |                 |         |
| Farmer                       | 322   | 29 (9)          | 0.313   |
| Civil servant                | 17    | 1 (5.9)         |         |
| Self-Employee                | 10    | 0 (0)           |         |
| NGO employee                 | 6     | 1 (16.7)        |         |
| Other                        | 19    | 4 (21.1)        |         |

Note: * Significant at 95% confidence interval
| Exposure factors                                | N   | HBsAg +ve (%) | P value |
|------------------------------------------------|-----|---------------|---------|
| Blood transfusion history                       |     |               |         |
| Yes                                            | 24  | 4 (16.7)      | 0.058*  |
| No                                             | 350 | 20 (5.7)      |         |
| Surgical history                               |     |               |         |
| Yes                                            | 58  | 7 (6.4)       | 0.056*  |
| No                                             | 316 | 17 (5.4)      |         |
| Multiple site surgeon                          |     |               |         |
| Yes                                            | 5   | 1 (20)        | 0.453   |
| No                                             | 41  | 4 (9.8)       |         |
| Tooth extraction                               |     |               |         |
| Yes                                            | 210 | 14 (6.7)      | 0.824   |
| No                                             | 164 | 10 (6.1)      |         |
| Hospitalization in last 2 years                |     |               |         |
| Yes                                            | 62  | 4 (6.5)       | 1       |
| No                                             | 311 | 20 (6.4)      |         |
| Medical field exposure                         |     |               |         |
| Yes                                            | 38  | 2 (5.3)       | 1       |
| No                                             | 335 | 22 (6.6)      |         |
| HBV Vaccination                                |     |               |         |
| Yes                                            | 1   | 0             | 1       |
| No                                             | 373 | 24 (6.4)      |         |
| Had Multiple sex partners                      |     |               |         |
| Yes                                            | 149 | 10 (6.7)      | 0.859   |
| No                                             | 224 | 14 (6.2)      |         |
| Had more than 4 sex partners                   |     |               |         |
| Yes                                            | 31  | 1 (3.2)       | 0.447   |
| No                                             | 342 | 23 (6.7)      |         |
| History of using condom                        |     |               |         |
| Yes                                            | 39  | 3 (7.7)       | 0.728   |
| No                                             | 335 | 21 (6.3)      |         |
| History of sharing personal materials          |     |               |         |
| Yes                                            | 228 | 17 (7.5)      | 0.306   |
| No                                             | 146 | 7 (4.8)       |         |
| History of ear or nose piercing                |     |               |         |
| Yes                                            | 7   | 0             | 1       |
| No                                             | 366 | 24 (6.6)      |         |
| Injury with a used sharp/piercing material     |     |               |         |
| Yes                                            | 224 | 16 (7.1)      | 0.484   |
| No                                             | 150 | 8 (5.3)       |         |
| Living with Hepatitis B or C infected person   |     |               |         |
| Yes                                            | 15  | 2 (13.3)      | 0.249   |
| No                                             | 359 | 22 (6.1)      |         |
| Had at least one STD                           |     |               |         |
| Yes                                            | 57  | 1 (1.8)       | 0.148   |
| No                                             | 317 | 23 (7.3)      |         |
| HIV status                                     |     |               |         |
| Positive                                       | 14  | 0             | 0.61    |
| Negative                                       | 252 | 17 (6.7)      |         |

Note: * Borderline significant at 95% confidence interval
| Exposure factors                          | N   | Anti-HCV +ve (%) | P value |
|------------------------------------------|-----|-----------------|---------|
| Blood transfusion history                |     |                 |         |
| Yes                                      | 24  | 6 (25)          | 0.007*  |
| No                                       | 350 | 29 (8.3)        |         |
| Surgical history                         |     |                 |         |
| Yes                                      | 58  | 4 (6.4)         | 0.627   |
| No                                       | 316 | 31 (9.8)        |         |
| Multiple site surgeon                    |     |                 |         |
| Yes                                      | 5   | 1 (20)          | 0.379   |
| No                                       | 41  | 3 (7.3)         |         |
| Tooth extract                            |     |                 |         |
| Yes                                      | 210 | 23 (11)         | 0.231   |
| No                                       | 164 | 12 (7.3)        |         |
| Hospitalization in last 2 years          |     |                 |         |
| Yes                                      | 62  | 9 (14.5)        | 0.129   |
| No                                       | 311 | 26 (8.4)        |         |
| Medical field exposure                   |     |                 |         |
| Yes                                      | 38  | 2 (5.3)         | 0.599   |
| No                                       | 335 | 33 (9.9)        |         |
| Had Multiple sex partners                |     |                 |         |
| Yes                                      | 149 | 11 (7.4)        | 0.28    |
| No                                       | 224 | 25 (10.7)       |         |
| Had more than 4 sex partners             |     |                 |         |
| Yes                                      | 31  | 1 (2.9)         | 0.338   |
| No                                       | 342 | 34 (9.9)        |         |
| History of using condom                  |     |                 |         |
| Yes                                      | 39  | 0               | 0.037*  |
| No                                       | 335 | 35 (10.4)       |         |
| History of sharing personal materials    |     |                 |         |
| Yes                                      | 228 | 24 (10.5)       | 0.332   |
| No                                       | 146 | 11 (7.5)        |         |
| History of ear or nose piercing          |     |                 |         |
| Yes                                      | 7   | 1 (14.3)        | 0.501   |
| No                                       | 366 | 34 (9.3)        |         |
| Injury with a used sharp/piercing material|   |                 |         |
| Yes                                      | 224 | 27 (12.1)       | 0.029*  |
| No                                       | 150 | 8 (5.3)         |         |
| Living with Hepatitis B or C infected person| |         |         |
| Yes                                      | 15  | 0               | 0.379   |
| No                                       | 359 | 35 (9.7)        |         |
| Had at least one STD                     |     |                 |         |
| Yes                                      | 57  | 3 (5.3)         | 0.328   |
| No                                       | 317 | 32 (10.1)       |         |
| HIV status                               |     |                 |         |
| Positive                                 | 14  | 0               | 0.374   |
| Negative                                 | 252 | 28 (11.1)       |         |

Note: * Significant at 95% confidence interval