



## Sero-epidemiology of human immunodeficiency virus, hepatitis B and C viruses, and syphilis infections among first-time blood donors in Edéa, Cameroon

Jean Jacques N. Noubiap<sup>a,\*</sup>, Walburga Yvonne A. Joko<sup>b</sup>, Jobert Richie N. Nansseu<sup>c</sup>, Ulrich Gaël Tene<sup>d</sup>, Christian Siaka<sup>e</sup>

<sup>a</sup> Internal Medicine Unit, Edéa Regional Hospital, Edéa, Cameroon

<sup>b</sup> Internal Medicine Unit, Douala General Hospital, Douala, Cameroon

<sup>c</sup> Hematology Unit, Mother and Child Centre, Chantal Biya Foundation, Yaoundé, Cameroon

<sup>d</sup> Pediatric Unit, Edéa Regional Hospital, Edéa, Cameroon

<sup>e</sup> Blood Transfusion Unit, Edéa Regional Hospital, Edéa, Cameroon

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### SUMMARY

**Background:** Blood safety remains an issue of major concern in transfusion medicine in sub-Saharan Africa. Blood-borne agents such as the human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and *Treponema pallidum* are among the greatest threats to blood safety for the recipient. This study aimed to determine the seroprevalence and risk factors of HIV, HCV, HBV, and syphilis infections among first-time blood donors at the new hospital-based blood bank in Edéa, Cameroon.

**Methods:** We carried out a retrospective analysis of blood donor data recorded between December 2011 and May 2012 at the blood bank of the Edéa Regional Hospital. Antibodies to HIV types 1 and 2 were screened with the Determine and ImmunoComb tests. Hepatitis B surface antigen and antibodies to HCV were detected using DIASpot test strips. Syphilis was diagnosed using the Venereal Disease Research Laboratory (VDRL) test and the *Treponema pallidum* hemagglutination assay (TPHA).

**Results:** A total of 543 blood donors were included, among whom 349 (64.3%) were family replacement donors. One hundred and fifteen donors (21.2%) were infected with at least one pathogen. The overall seroprevalence rates of HIV, HBV, HCV, and syphilis were 4.1%, 10.1%, 4.8%, and 5.7%, respectively. We found a total of 26 dual infections. The most common combinations were HBV–HCV and HBV–HIV. There was a significant association between HIV and HBV infections (adjusted odds ratio (aOR) 3.46, 95% CI 1.29–9.39;  $p = 0.014$ ), and between HBV and HCV infections (aOR 2.81, 95% CI 1.02–10.12;  $p = 0.036$ ). Compared to voluntary donors, family replacement donors were significantly more infected by at least one screened pathogen (aOR 1.81, 95% CI 1.14–2.88;  $p = 0.013$ ), and more infected specifically by HIV (aOR 3.66, 95% CI 1.07–12.55;  $p = 0.039$ ) and syphilis (aOR 2.81, 95% CI 1.05–7.46;  $p = 0.039$ ).

**Conclusions:** Our findings indicate that blood safety remains a major problem in Cameroon where hospital-based blood banks and family replacement donors are predominant. There is an urgent need for a national blood transfusion program in Cameroon that will establish a nationally coordinated blood transfusion service based on the principles of voluntary regular non-remunerated blood donation.

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### 1. Introduction

Blood transfusion is an important therapeutic act that saves millions of lives. It is estimated that more than 90 million blood units are collected in the world each year.<sup>1</sup> However, in spite of the benefits of blood transfusion, each transfused patient is at risk of acquiring transfusion-transmissible infections (TTIs),

principally the human immunodeficiency virus (HIV), hepatitis B and C viruses (HBV and HCV), and *Treponema pallidum*, the pathologic agent of syphilis. Transfusion of contaminated blood has disastrous health consequences in terms of morbidity and mortality due to acquired infections, and this is associated with important economic losses incurred in treating these patients who later become dependent and non-productive. Although African countries actually face the greatest demand for transfusion products in the world, and are the countries where the prevalence of TTIs are highest, the blood transfusion programs in these countries are equally the most inadequate.<sup>2</sup>

\* Corresponding author at: Internal Medicine Unit, Edéa Regional Hospital, PO Box 100, Edéa, Cameroon. Tel.: +237 79644081.

E-mail addresses: [noubiapjj@yahoo.fr](mailto:noubiapjj@yahoo.fr), [noubiapjj@gmail.com](mailto:noubiapjj@gmail.com) (J.J.N. Noubiap).

To improve blood safety in Africa, the World Health Organization (WHO) has adopted a strategy for Africa that aims to implement a national policy for each African country by 2012, in order to assure a safe and sufficient blood supply. This strategy includes the recruitment of regular, voluntary non-remunerated blood donors, screening for all major TTIs in a quality controlled manner, appropriate infrastructure, qualified personnel, and financial resources.<sup>3</sup>

In July 2011, the Edéa Regional Hospital (ERH) was inaugurated in the Littoral Region of Cameroon, and 4 months later a blood bank was opened in this hospital. The aim of this study was to determine the seroprevalence and risk factors of HIV, HCV, HBV, and syphilis infections among first-time blood donors at the new hospital-based blood bank in Edéa, Cameroon. This will serve as a baseline in the monitoring of the prevalence of these TTIs in the population of Edéa, which will help in formulating strategies for improving blood transfusion safety.

## 2. Materials and methods

### 2.1. Study design and setting

We conducted a retrospective analysis of blood donor data recorded between December 2011 and May 2012 at the blood bank of the ERH. Situated 66 km from Douala and 180 km from Yaoundé, the respective economic and political capitals of Cameroon, the ERH is the referral hospital for four health districts that cover a total population estimated at 300 000 inhabitants. This hospital also has as its objective the management of the numerous accidents along the Douala–Yaoundé and the Kribi–Edéa highways, management which often requires blood transfusions.

### 2.2. Study population

Donors were either volunteers, or relatives or friends of patients who came to replace blood used or expected to be used by patients. Voluntary donors either belonged to an association of blood donors or came individually on their own account to donate blood. Because the blood bank was new, they were almost exclusively first-time blood donors.

Donors were all apparently healthy subjects, aged between 18 and 65 years, weighing 50 kg or more, with a hemoglobin level  $\geq 12.5$  g/dl, and without serious illness, jaundice, sickle cell disease, or current fever. The socio-demographic characteristics of the selected donors were recorded in a database.

### 2.3. Sample collection

Blood samples were aseptically collected from each subject by venipuncture in 5-ml red-top vacutainers (Becton Dickinson, NJ, USA) and allowed to clot naturally at room temperature. Serum specimens were separated by centrifugation at 3000 g for 5 min and were used for the analyses.

### 2.4. HIV serology

HIV antibodies were detected by two rapid tests that detect both HIV-1 and HIV-2 infections: the ImmunoComb HIV 1&2 BiSpot (Orgenics, Courbevoie, France), an indirect solid-phase enzyme immunoassay that has a sensitivity of approximately 99.7% and a specificity of approximately 100%, and the Determine HIV-1/2 (Abbott Laboratories, IL, USA), an immunochromatographic assay that has a specificity of approximately 99.6% and a sensitivity of approximately 99.4%. All samples positive by both techniques were considered true positives, and those negative for

both methods were considered true negatives. All discordant samples were excluded from the present analysis.

### 2.5. Hepatitis B surface antigenemia

HBV was detected using a one-step immunoassay-based DIASpot HBsAg test kit (DIASpot Diagnostics, USA) for qualitative detection of hepatitis B surface antigen (HBsAg) in serum. This test has a relative sensitivity and specificity of 99% and 97.0%, respectively.

### 2.6. HCV serology

IgG antibodies to HCV were detected using DIASpot HCV-Ab test strips (DIASpot Diagnostics, USA), an immunochromatographic assay that has approximately 99.9% sensitivity and 98.6% specificity.

### 2.7. Syphilis serology

Syphilis was diagnosed using the Venereal Disease Research Laboratory (VDRL) test (Omega Diagnostic, UK) and the *Treponema pallidum* hemagglutination assay (TPHA) test (Omega Diagnostic, UK). Active syphilis was diagnosed if an individual's blood tested positive with both tests. All samples positive for one test and negative for the other were excluded from the present analysis.

### 2.8. Statistical analysis

Data were coded, entered, and analyzed using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA). The seroprevalences of HIV, HCV, HBV, and syphilis were expressed in percentages of the entire study group and by age, sex, and donor category. Odds ratios (OR) with 95% confidence intervals (CI) were used to appreciate the impact of different variables on HIV, HBV, HCV, and syphilis seropositivity. We calculated the ORs by both univariate and multivariate logistic regression analysis, with adjustments for age, gender, and type of blood donor. *p*-Values of less than 0.05 were considered statistically significant.

### 2.9. Ethical considerations

In conformity with the procedure for blood donation implemented at the blood bank of the ERH, all donors were informed that their blood sample would be tested for TTIs and that the results would be kept strictly confidential. Pre- and post-test counseling were subsequently done, and donors with positive results for any of the TTIs were referred to medical doctors in charge of the internal medicine unit for complementary work-up and appropriate management.

Institutional authorization from the authorities at the ERH was obtained prior to carrying out this study.

## 3. Results

Five hundred and forty-three donors were included in the present analysis. Their ages ranged from 18 to 62 years, with a mean age of  $32.5 \pm 9.4$  years. The male/female ratio was 4.5 (445/98). Of the total donors, 35.7% (95% CI 31.7–39.9%,  $n = 194$ ) were voluntary donors. There was no significant difference in age ( $p = 0.195$ ) or gender ( $p = 0.483$ ) between family replacement and voluntary donors (Table 1).

The overall seroprevalence rates of HIV, HBV, HCV, and syphilis were 4.1% (95% CI 2.6–6.2%,  $n = 22$ ), 10.1% (95% CI 7.8–13.1%,  $n = 55$ ), 4.8% (95% CI 3.2–7.0%,  $n = 26$ ), and 5.7% (95% CI 4.0–8.1%,  $n = 31$ ), respectively. Of all donated blood during the study period,

**Table 1**  
Socio-demographic characteristics of 543 first-time blood donors in the Edéa Regional Hospital, Cameroon

Characteristics	Number (%)	95% CI, %
Gender		
Female	98 (18)	15.0–21.6
Male	445 (82)	78.4–85.0
Age group, years		
≤20	30 (5.5)	3.8–7.9
21–30	236 (43.5)	39.3–47.8
31–40	171 (31.5)	27.6–35.6
41–50	77 (14.2)	11.4–17.5
>50	29 (5.4)	3.7–7.7
Type of donation		
Volunteer	194 (35.7)	31.7–39.9
Family replacement	349 (64.3)	60.1–68.3

CI, confidence interval.

21.2% (95% CI 17.9–24.9%,  $n = 115$ ) had serological evidence of infection with at least one pathogen. Significantly more family replacement donors were seropositive for at least one of the screened pathogens than voluntary donors (adjusted odds ratio (aOR) 1.81, 95% CI 1.14–2.88;  $p = 0.013$ ). Family replacement donors were also significantly more infected by HIV (aOR 3.66, 95% CI 1.07–12.55;  $p = 0.039$ ) and syphilis (aOR 2.81, 95% CI 1.05–7.46;  $p = 0.039$ ). The seroprevalence of syphilis was significantly increased in donors over 50 years of age (aOR 4.57, 95% CI 1.69–12.35;  $p = 0.003$ ). There were no other statistically significant differences in seroprevalence of these infections between age groups, males and females, and types of donor (Tables 2–5). We found a total of 26 dual infections. The most common dual infections were HBV-HCV and HBV-HIV (Table 6). The risk of HIV-positive donors being positive for HBV was statistically significant (aOR 3.46, 95% CI 1.29–9.39;  $p = 0.014$ ), but this was not observed for syphilis (aOR 2.78, 95% CI 0.78–9.96;  $p = 0.102$ ) or for HCV (OR 3.42, 95% CI 0.94–12.39;  $p = 0.047$ ; but no significance after adjustment). The risk of HBV-positive donors being positive for HCV was statistically significant (aOR 2.81, 95% CI 1.02–10.12;  $p = 0.036$ ) (Table 6).

#### 4. Discussion

One of the main recommendations of the WHO to achieve a safe and sufficient blood supply is the collection of blood from voluntary regular non-remunerated donors who have a lower risk of TTIs compared to family replacement and commercial donors.<sup>3–5</sup> Only 35.7% of donors in our study were voluntary non-remunerated donors. This is far from the 80–100% voluntary donations advocated by the WHO.<sup>3</sup> In our study we found that 21.2% of the donated blood was seropositive for at least one of the screened pathogens. This very high prevalence can be explained by

the predominance of family replacement donors who were significantly more infected than voluntary donors (aOR 1.81, 95% CI 1.14–2.88;  $p = 0.013$ ). Indeed, the seroprevalence of HIV and syphilis were significantly increased among family replacement donors compared to voluntary donors ( $p = 0.039$  for both HIV and syphilis). This higher seroprevalence in family replacement donors was also noted for HBV and HCV, though the differences were not statistically significant ( $p = 0.432$  and  $p = 0.072$ , respectively). These results, which are in keeping with those of other studies,<sup>6–8</sup> strongly indicate that family replacement donors are less suitable for blood donation. These higher prevalence rates in family replacement donors compared to voluntary donors could be explained by the fact that people who voluntarily commit themselves to regularly donate blood consider their blood safe, because they do not have high-risk behaviors such as multiple sex partners, intravenous drug abuse, or unprotected sexual intercourse. On the contrary, a proportion of replacement donors, who give blood because of urgent need, have these high-risk behaviors and thus are more prone to be infected by these pathogens.

Although replacement blood donation is less safe, as shown by Tapko et al. in many sub-Saharan African countries, family replacement donors remain remarkably predominant, reaching over 70% of blood donor populations in most instances.<sup>4</sup> Much more, in Africa 75–80% of the blood for transfusion still comes from replacement hospital-based donors.<sup>5</sup> The very high prevalence of infected blood donors in our study calls for a more sensitive and stringent screening of donated blood and for a major emphasis on encouraging voluntary regular blood donation. As recommended by the WHO,<sup>4</sup> there is a need for a national blood transfusion program in Cameroon that will ensure the quality, safety, availability, and accessibility of blood transfusion within the country.

In Cameroon, the prevalence of HIV in donated blood was estimated at 8.2% in 2000.<sup>9</sup> Accordingly, in 2003 Mbanya et al. found a 7.9% prevalence of HIV among first-time blood donors in Yaoundé, Cameroon.<sup>10</sup> The 4.1% prevalence found in our study suggests that there may have been a decrease in the prevalence of HIV in donated blood through this last decade. This could be a result of the prevention programs that have been instituted in this last decade. However the prevalence is still high, and the risk of HIV infection through blood transfusion remains significant in Cameroon as in other African countries, since diagnostic methods like the detection of the p24 antigen and viral genome screening, which reduce the silent window period, are not regularly used in Africa, except in South Africa, Egypt, and Ghana.<sup>5</sup>

Various seroprevalence rates of HBV have been reported in African donors. The highest seroprevalence rates have been found among donors in countries like Nigeria (18.6%),<sup>11</sup> Guinea-Bissau (16.2%),<sup>4</sup> Mauritania (16.51%),<sup>4</sup> Burkina Faso (14.96%),<sup>12</sup> Senegal

**Table 2**  
Relationship between socio-demographic characteristics and HBV seropositivity among 543 first-time blood donors in the Edéa Regional Hospital, Cameroon

Characteristics	Total	HBV-positive, $n$ (%)	OR (95% CI)	$p$ -Value	aOR (95% CI)	$p$ -Value
Age group, years						
≤20	30	3 (10)	0.99 (0.29–3.36)	0.639	NS	0.981
21–30	236	23 (9.7)	0.94 (0.59–1.66)	0.840	NS	0.840
31–40	171	19 (11.1)	1.00			
41–50	77	7 (9.1)	0.87 (0.38–2.00)	0.745	NS	0.745
>50	29	3 (10.3)	1.03 (0.30–3.51)	0.580	NS	0.968
Gender						
Female	98	6 (6.1)	1.00			
Male	445	49 (11)	2.00 (0.79–4.57)	0.146	NS	0.146
Type of donor						
Volunteer	194	17 (8.8)	1.00			
Family replacement	349	38 (10.9)	1.27 (0.67–2.43)	0.432	NS	0.432

OR, unadjusted odds ratio; aOR, adjusted odds ratio (each parameter is adjusted for the two others); CI, confidence interval; NS, adjustments made no significant difference to the analysis (data not shown).

**Table 3**

Relationship between socio-demographic characteristics and HCV seropositivity among 543 first-time blood donors in the Edéa Regional Hospital, Cameroon

Characteristics	Total	HCV-positive, n (%)	OR (95% CI)	p-Value	aOR (95% CI)	p-Value
Age group, years						
≤20	30	2 (6.7)	1.46 (0.33–6.45)	0.428	NS	0.620
21–30	236	12 (5.1)	1.14 (0.52–2.51)	0.747	NS	0.747
31–40	171	5 (2.9)	1.00			
41–50	77	5 (6.5)	1.47 (0.54–4.03)	0.303	NS	0.449
>50	29	2 (6.9)	1.51 (0.34–6.76)	0.411	NS	0.585
Gender						
Female	98	5 (5.1)	1.00			
Male	445	21 (4.7)	0.92 (0.32–2.87)	0.519	NS	0.872
Type of donor						
Volunteer	194	5 (2.6)	1.00			
Family replacement	349	21 (6)	2.42 (0.85–7.45)	0.072	NS	0.072

OR, unadjusted odds ratio; aOR, adjusted odds ratio (each parameter is adjusted for the two others); CI, confidence interval; NS, adjustments made no significant difference to the analysis (data not shown).

(12.7%),<sup>4</sup> and Mozambique (10.6%).<sup>13</sup> The 10.1% seroprevalence found in our study is similarly high. This seroprevalence is almost equal to the 10.7% found among first-time Cameroonian donors by Mbanya et al. in Yaoundé in 2003,<sup>10</sup> indicating that the burden of hepatitis B has not decreased in Cameroon through this last decade. Our findings also point out that younger donors are almost equally infected by HBV as older donors, indicating that there is a young age at acquisition of HBV among these donors. The younger age at acquisition of HBV is the most important predictor of the chronic carrier state of the infection, which may lead to chronic hepatitis, cirrhosis, and hepatocellular carcinoma.<sup>14,15</sup> As hepatitis B vaccination has recently been included in the Expanded Program on Immunization in Cameroon, a decrease in hepatitis B prevalence in the general population is expected in the next decades.

In our study, 4.8% of donors were positive for HCV antibodies. This corresponds to the findings of Mbanya et al. who found exactly a 4.8% prevalence of HCV among first-time blood donors in 2003, in Yaoundé, Cameroon.<sup>10</sup> This indicates a probable constant trend in the seroprevalence of HCV among blood donors in Cameroon. Various seroprevalence rates of HCV among blood donors have been reported in other African studies. In Mali, Diarra et al. reported a seroprevalence of 13.9%;<sup>16</sup> in Burkina Faso, Nagalo et al. reported a seroprevalence of 8.69%;<sup>12</sup> in Tanzania and Nigeria, Matee et al. and Buseri et al. reported prevalence rates of 1.5% and 6%, respectively;<sup>11,17</sup> in Mozambique, there was no HCV infection among 679 blood donors.<sup>17</sup> These seroprevalence rates are globally higher than values ranging between 0% and 1.4% reported in USA and Europe.<sup>18,19</sup>

HCV is typically transmitted through blood contact (e.g., blood transfusion, invasive medical procedures, and intravenous drug injection). As blood transfusion is a major route of transmission in the African context, blood products safe from HCV should permit a

constant reduction in the HCV prevalence and its consequences, such as chronic hepatitis, liver cirrhosis, and hepatocellular carcinoma.

Our findings in accordance with those of other African studies indicate a decreasing trend in the seroprevalence of syphilis among blood donors in some African countries. For example, this seroprevalence has decreased in Cameroon from 14.4% in 2002<sup>20</sup> to 5.7% in our study; in Tanzania, from 12.7% in 1999 to 4.7% in 2006<sup>17,21</sup> and in Ghana, from 13.5% in 2002 to 4.7% in 2009.<sup>22,23</sup> This decrease may be related to a positive effect of the prevention programs against HIV, as syphilis is a sexually transmitted disease. Moreover, the prevalence of syphilis found in these African studies may have been increased by false-positive results due to the detection of other treponemes that are endemic in Africa, such as pian, b $\acute{e}$ jel, and pinta, which cannot be differentiated from syphilis by serologic tests.<sup>24</sup>

With regard to the co-infections, there was a significant association between HIV and HBV. As shown by other studies, this association could be due to the fact that these infections share similar modes of transmission (predominantly blood and high-risk sexual behaviors).<sup>11,25,26</sup> Others studies have shown an association between HIV and syphilis, due to the fact that they are sexually transmitted and especially because syphilis has skin lesions that promote the transmission of the HIV.<sup>27</sup> The overall prevalence of dual infections (4.8%) in our study is not insignificant.

We found a considerable male predominance (82%) in blood donation in our setting, a trend observed in many African countries.<sup>5</sup> This male dominance may be explained by the fact that in the African context there is a general belief that men are healthier than women,<sup>28,29</sup> and thus are more suitable for blood donation. In addition, women are said to make monthly blood donations to nature through their menstrual cycle. Other

**Table 4**

Relationship between socio-demographic characteristics and HIV seropositivity among 543 first-time blood donors in the Edéa Regional Hospital, Cameroon

Characteristics	Total	HIV-positive, n (%)	OR (95% CI)	p-Value	aOR (95% CI)	p-Value
Age group, years						
≤20	30	0 (0)	1.06 (1.04–1.08)	0.279	NS	0.282
21–30	236	10 (4.2)	1.10 (0.47–2.60)	0.819	NS	0.881
31–40	171	6 (3.5)	1.00			
41–50	77	5 (6.5)	1.83 (0.66–5.13)	0.189	NS	0.283
>50	29	1 (3.4)	0.84 (0.11–6.45)	0.669	NS	0.752
Gender						
Female	98	3 (3.1)	1.00			
Male	445	19 (4.3)	1.41 (0.41–4.88)	0.417	NS	0.541
Type of donor						
Volunteer	194	3 (1.5)	1.00		1.00	
Family replacement	349	19 (5.4)	3.66 (1.07–12.55)	0.027	3.66 (1.07–12.55)	0.039

OR, unadjusted odds ratio; aOR, adjusted odds ratio (each parameter is adjusted for the two others); CI, confidence interval; NS, adjustments made no significant difference to the analysis (data not shown).

**Table 5**  
Relationship between socio-demographic characteristics and syphilis seropositivity among 543 first-time blood donors in the Edéa Regional Hospital, Cameroon

Characteristics	Total	Syphilis positive, n (%)	OR (95% CI)	p-Value	aOR (95% CI)	p-Value
Age group, years						
≤20	30	1 (3.3)	0.62 (0.07–4.22)	0.477	NS	0.663
21–30	236	10 (4.2)	0.61 (0.28–1.33)	0.210	NS	0.179
31–40	171	8 (4.7)	1.00		1.00	
41–50	77	6 (7.8)	1.49 (0.59–3.76)	0.267	NS	0.452
>50	29	6 (20.7)	5.10 (1.91–13.70)	0.004	4.57 (1.69–12.35)	0.003
Gender						
Female	98	6 (6.1)	1.00			
Male	445	25 (5.6)	0.91 (0.36–2.29)	0.846	NS	0.848
Type of donor						
Volunteer	194	5 (2.6)	1.00		1.00	
Family replacement	349	26 (7.4)	3.04 (1.15–8.06)	0.019	2.81 (1.05–7.46)	0.039

OR, unadjusted odds ratio; aOR, adjusted odds ratio (each parameter is adjusted for the two others); CI, confidence interval; NS, adjustments made no significant difference to the analysis (data not shown).

**Table 6**  
Associations in the occurrence of HIV, HCV, HBV, and syphilis among 543 first-time blood donors in the Edéa Regional Hospital, Cameroon<sup>a</sup>

Characteristics	n (%)	OR (95% CI)	p-Value	aOR (95% CI)	p-Value
HIV–HBV	6 (23.1)	3.61 (1.35–9.66)	0.007	3.48 (1.29–9.39)	0.014
HIV–HCV	3 (11.5)	3.42 (0.94–12.39)	0.047	NS	0.202
HIV–syphilis	3 (11.5)	2.78 (0.78–9.96)	0.102	NS	0.199
HBV–syphilis	4 (15.4)	1.34 (0.45–3.98)	0.386	NS	0.742
HBV–HCV	6 (23.1)	2.87 (1.10–7.47)	0.025	2.81 (1.07–7.39)	0.036
HCV–syphilis	4 (15.4)	3.30 (1.06–10.25)	0.054	3.22 (1.02–10.12)	0.045

OR, unadjusted odds ratio; aOR, odds ratio after adjusting for age, gender and type of donor; CI, confidence interval; NS, adjustments for age, gender and type of donor made no significant difference to the analysis (data not shown).

<sup>a</sup> Total of dual infections: n=26.

obstetrical factors including pregnancy and breastfeeding further restrict many women from donating blood.<sup>5</sup>

This study has some limitations, especially concerning the accuracy of the diagnosis of HBV and HCV infections. We used rapid tests which, in a recent international quality control of blood-borne virus testing carried out in six African blood banks, have been shown to have poor sensitivity compared to enzyme immunoassays (EIAs) for the detection of HCV antibodies and HBsAg.<sup>30</sup> In terms of specificity, we did not perform confirmatory testing for anti-HCV- and HBsAg-positive samples, and therefore we may have overestimated the prevalence of HBV and HCV infections through the inclusion of some false-positives.

In conclusion, this high (21.2%) seroprevalence of TTIs in blood donated at the ERH's blood bank is alarming and indicates that blood safety remains an issue of major concern in Cameroon, as in other developing countries where hospital-based blood banks and family replacement donors are predominant. There is an urgent need for a national blood transfusion program in Cameroon that will establish a nationally coordinated blood transfusion service based on the principles of voluntary regular non-remunerated blood donation.

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