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Seroprevalence of HIV, Hepatitis B and C and Syphilis among Irregular Voluntary Blood Donors at the National Blood Transfusion Sanguine (CNTS)/Bangui in the Central African Republic in 2022

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Abstract

Objective: This paper aims to determine the seroprevalence of HIV, Hepatitis B and C, and Syphilis among irregular blood donors at the CNTS in CAR. **Methodology:** This was a prospective descriptive and analytical study conducted from January to December 2022, focusing on irregular blood donors. The survey included samples taken at blood collection sites in Bangui and surrounding areas. Data on socio-demographic characteristics and test results were collected through literature reviews and laboratory registers. Biological screening for HIV, HBV, and HCV was performed using a liquid-based enzyme-linked immunosorbent assay (ELISA) with antibodies and/or antigens. A combined fourth-generation Linked Immunosorbent Assay was used for HIV and Hepatitis B and C viruses. Anti-treponemal antibodies were detected using the RPR Charbon diagnostic technique and confirmed by the Treponema Pallidum Haemagglutination Assay if positive. **Results:** From January to December 2022, we registered 22,500 blood donors, of whom 6989 (31%) were first-time donors. Among these, 1574 (22.5%) tested positive for all four serological markers. The seroprevalence of HIV, HBV, HCV, and syphilis infections was 5.56%, 10.11%, 0.18%, and 4.97%, respectively. The 26 - 35 age group was the most represented at 29.73%, followed by the 18 - 25 age group at 24.58%. Males accounted for 88.95%. Regarding occupation, 65.29%

worked in the private sector, and the Free Union population showed a high frequency of 72.87%. Most first-time donors came from the 4th Arrondissement (26.73%). We found a significant association between the 18 - 35 age group ($p = 0.0002$) and syphilis. Civil servants and those working in the private sector showed a significant association with HIV ($p < 0.05$). Statistical tests showed significant associations between civil servants, those in the private sector, pupils/students, the unemployed, and HCV ($p < 0.05$). Single individuals and those in common-law relationships showed a statistically significant association with HIV, HBS, and HCV ($p < 0.05$). There was a significant difference between those living in Bangui and syphilis ($p < 0.009$). The proportion of co-infections was 10.61% (167/1574), with a predominance of HIV/HBS co-infection in 5.40% of cases (85/1574), showing a significant association ($p < 0.001$), followed by HIV/Syphilis in 5.40% of cases (17/1574). Irregular donors were four times more likely to be co-infected with HIV/HBS (RR = 4.32). Statistical tests showed a significant association between irregular donors and different types of co-infection ($p < 0.05$). **Conclusion:** This study revealed a significant presence of HBS antigen, anti-HIV, and RPR antibodies in irregular donors in CAR, leading to a loss of status.

Keywords

Seroprevalence, HIV, HBS, HCV, RPR, Irregular Donors, CNTS, RCA

1. Introduction

Blood transfusion involves administering blood or its components—red blood cells, platelets, granulocytes, plasma, proteins—from healthy donors to sick recipients. Approximately 118.5 million blood donations are collected worldwide annually, with 40% coming from high-income countries, which house 16% of the world's population. About 13,300 blood transfusion centers in 169 countries reported collecting a total of 106 million donations [1]. In most sub-Saharan African countries, transfusion safety has significantly improved. These advancements include systematic serological screening of all blood donations for HIV, hepatitis B and C, and Treponema pallidum, as well as selecting blood donors at low risk of transmitting these pathogens [2] [3]. One in four low-income countries does not test all blood donations, and 54% of countries lack surveillance systems to secure the supply chain from donor to patient [1]. According to the World Health Organization (WHO), the African region, comprising 47 countries, has a high prevalence of communicable and non-communicable diseases and high maternal and infant mortality rates. The average percentage of people suffering from anemia is 42%. Blood transfusion plays an essential role in treating these diseases [4]. In the Central African Republic (CAR), as in other low-income African countries, blood transfusion is a public health issue. In 2022, 22,500 bags of whole blood were collected in CAR, or 3.7 per 1000 inhabitants. This rate is below the WHO-recom-

mended standard of 10 per 1000 inhabitants and does not meet the country's needs, estimated at 53,603 donations for a population of 6,091,097 according to ICASEES RGPH 4 mapping in 2022. Every month, 4467 blood donations are needed to cover all therapeutic needs, which cannot be replaced by any synthetic product, yet only 1875 volunteers donate blood. The National Blood Transfusion Center (CNTS) is the only national reference center for blood transfusion, equipped to test blood bags before transfusion. Following the military-political crisis, blood collection is problematic due to a scarcity of volunteer donors. As a result, the CNTS is welcoming all candidates for blood donation to increase the number of blood bags available to meet the population's needs. A regular blood donor is defined as someone who donates at least twice consecutively. Other types include irregular donors, such as family, compensation, or occasional donors who come forward during transfusion emergencies. The blood donor collection procedure begins with a pre-donation questionnaire to select eligible candidates. Unfortunately, some irregular donors do not answer the questionnaire objectively and are eliminated after serological analysis. This practice increases the risk of Transfusion Transmissible Infections (TTIs). Additionally, cultural barriers prevent some people from donating blood regularly. Previous studies have been conducted in CAR on blood donors, but there seems to be little interest in irregular donors [5] [6]. Screening for various infectious agents during blood donation helps prevent their transmission during transfusion of whole blood or its derivatives. This study aims to determine the seroprevalence of four serological markers (HIV, Hepatitis B, Hepatitis C, and Syphilis) in irregular blood donors at the CNTS in CAR.

2. Materials and Methods

This was a prospective descriptive and analytical from January to December 2022, conducted in the Immunoserology Department at the CNTS in Bangui, CAR. Sampling was exhaustive and included blood analysis results from first-time and irregular donors. It also included those who made compensatory, family, or occasional donations, with the number of donations being two or more. During the study, blood was collected from 114 sites in Bangui: Poste Fixe, a mobile team, and 22 advanced-strategy sites in the provinces. At these sites, a blood donation campaign is organized two to three days before blood is drawn from donors selected based on a pre-donation medical questionnaire and informed consent. Data on socio-demographic characteristics—age, sex, occupation, marital status, and place of residence—and the results of biological qualification were collected from the registers of the blood collection department and the immuno-serology unit.

3. Biological Diagnosis

Biological screening for serological markers (HIV, HBV, and HCV) was conducted using a liquid-based enzyme-linked immunosorbent assay (ELISA) with antibodies and/or antigens. The combined fourth-generation ELISA for HIV,

Hepatitis B, and C viruses was also used. For syphilis, antitreponemal antibodies were detected using the RPR Charbon (Rapid Plasma Reagin) diagnostic technique. If positive, a quantitative test was performed using the Treponema pallidum hemagglutination assay (TPHA) to titrate antitreponemal antibodies. To confirm infection, a second test is performed on another sample after 21 days. Low, stable titers are considered serological scars.

4. Statistical Analysis

The data collected were coded, manually tabulated, processed, and analyzed using Office Excel 2007 and Epi Info version 3.5.1 to generate descriptive statistics. Univariate and bivariate analyses were performed to extract tables and figures with a risk α of 5% and a confidence interval of 95%. The test was considered statistically significant.

5. Results

From January to December 2022, 22,500 blood donors were registered. Of these, 6989 (31%) were first-time donors, and 1574 (22.52%) were infected with serological markers for HIV, Hepatitis B and C, and Syphilis, distributed as follows: 5.56% for HIV, 10.11% for Hepatitis B, 1.86% for Hepatitis C, and 4.98% for Syphilis. The 26 - 35 age group was the most represented at 29.73%, followed by the 18 - 25 age group at 24.58%. Males accounted for 88.95% of donors. In terms of occupation, 65.29% worked in the private sector. The Free Union population had a high frequency of 72.87%, and the majority of first-time donors came from the 4th Arrondissement at 26.73%. Table 1 presents data on socio-demographic characteristics.

We found a significant association between the 18 - 35 age group ($p = 0.0002$) and syphilis. Civil servants and those working in the private sector showed a significant association with HIV ($p < 0.05$). Various statistical tests indicated a significant association between civil servants, those working in the private sector, students/graduates, the unemployed, and HCV ($p < 0.05$). Single people and those in common-law relationships showed a statistically significant association with HIV, HBS, and HCV ($p < 0.05$). There was a significant difference between those living in Bangui and syphilis ($p = 0.009$). However, there was no significant association between gender and the four serological markers. Table 2 shows the association between serological markers and socio-demographic characteristics.

For the 6989 irregular donors registered, the proportion of co-infections was 10.61% (167/1574). Among the 1574 cases of HIV, HBS, HCV, and Syphilis infection, there was a predominance of HIV/HBS co-infection in 5.40% of cases (85/1574), with a significant association ($p < 0.001$), followed by HIV/Syphilis in 5.40% of cases (17/1574). First-time donors had four times the risk of being coinfected with HIV/HBS (RR = 4.32). Statistical tests showed a significant association between irregular donors and different types of co-infection ($p < 0.05$). The results for each type of co-infection are shown in Table 3.

Table 1. Distribution of non-prime donors by socio-demographic characteristics.

Serological markers	Number	HIV	HBS	HCV	SYPHILIS	Total
	n = 1574	n = 389	n = 707	n = 130	n = 348	
Age group		%	%	%	%	%
18 - 25 years	387	25.45	24.61	27.69	25.57	24.59
26 - 35 years	469	25.96	29.98	37.03	20.69	29.80
36 - 45 years	355	21.85	21.64	19.23	17.46	22.55
46 – 55 years	233	18.76	14.00	11.54	25.29	14.80
56 - 62 years	130	7.70	9.76	8.46	10.05	8.26
Gender						
Male	1401	88.95	88.97	89.23	89.08	89
Female	173	11.05	11.03	10.77	10.92	11
Occupation						
Students	252	17.47	13.05	23.08	15.80	16.01
Official	154	13.88	4.48	21.54	10.63	9.78
Private sector	1127	65.29	71.57	55.38	70.4	71.60
Unemployed	41	3.34	2.97	0	3.16	2.60
Family situation						
Single	421	22.62	31.26	29.23	25	26.75
Married	6	0	0	0	0	0.38
Free union	1147	77.38	68.74	70.08	75	72.87
Residence						
1th AR	29	2.05	1.27	3.07	1.72	1.84
2th AR	33	1.28	2.97	6.92	2.59	2.10
3th AR	139	9.51	5.51	10.8	13.22	8.83
4th AR	377	26.73	23.05	15.38	22.13	23.95
5th AR	282	21.85	16.83	16.92	14.94	17.92
6th AR	227	11.57	17.68	7.69	9.77	14.42
7th AR	172	10.28	10.32	9.23	11.49	10.93
8th AR	138	8.74	8.63	8.46	9.48	8.77
9th AR	120	3.08	9.91	8.46	9.48	7.62
10th AR	18	1.8	1	7.69	0.86	1.14
Peripheral	39	2.31	2.83	5.38	4.31	2.48

Table 2. Association between serological markers and socio-demographic characteristics.

Serological markers	Number	HIV		HBS		HCV		Syphilis	
	n = 1574	n = 389	p	n = 707	p	n = 130	p	n = 348	p
Age group									
18 - 35	856	200	0.08	386	0.43	79	0.06	161	0.0002
36 - 62	718	189		321		51		187	
Gender									
Male	1401	346	0.47	629	0.48	116	0.47	310	0.48
Female	173	43		78		14		38	
Occupation									
Students	252	68	0.19	92	0.14	30	0.0002	55	0.45
Official	154	54	0.005	32	0.05	28	0.0003	37	0.28
Private sector	1127	254	<0.001	506	0.40	72	<0.001	245	0.26
Unemployed	41	21	0.25	21	0.20	0	0.01	11	0.22
Family situation									
Single	421	88	0.001	221	0.0003	38	<0.001	87	0.2
Married	6	0		0		0		0	
Free union	1147	301	0.01	486	0.0004	495	<0.001	261	0.15
Residence									
Bangui	1535	382	0.16	687	0.21	123	0.02	333	0.009
Peripheral	39	7		20		7		15	

Table 3. Distribution of cases of co-infection in irregular donors.

Types of co-infection	n = 1574	%	p-value	RR
HIV/HBS	85	5.40	10^{-8}	4.32
HIV/HCV	27	1.71	0.09	0.76
HIV/Syphilis	29	1.84	0.19	0.83
HBS/HCV	17	1.08	0.0002	0.44
HBS/Syphilis	9	0.57	10^{-8}	0.22

6. Discussion

From January to December 2022, we recorded 22,500 blood donors, of whom 6989 (31%) were irregular donors. Of these, 1574 (22.5%) tested positive for all four serological markers. This result was lower than several studies. In Bangui from 2015 to 2019, Christian Maucler Pamatika *et al.* recorded 30,053 first-time donors, or 66.7% [5], and in Algeria in 2018, Sarah Ayad *et al.* found 50.5% [7]. However, it was higher than a study conducted in Mali in 2019 by Goita D. *et al.*, which revealed that out of 20,244 donors, 2595 were positive for at least one infectious

marker, giving an overall seroprevalence of 12.80% [8]. The low prevalence found in our study could be explained by the large sample sizes and different study durations compared to ours, which extends over one year. The implementation of a program to combat sexually transmitted infections (STIs), the creation of a national referral center for STI management, and the national STI management guidelines available since 2007 in the CAR have all contributed to a reduction in the prevalence rate of these four infectious markers in the population, including irregular donors [9]. The average age was 31 years, with a minimum of 18 years, and 24.59% of participants were in the 18 - 25 age group (**Table 1**). These results are similar to those of Goita D. *et al.*, who found a percentage of 38.40% in the 26 - 35 age bracket [8], and to Dembélé in 2020, where young people were predominantly represented at 27.8% [10]. This aligns with most blood donation studies, as young people are often more willing and able to donate blood than older populations. Some authors suggest this is linked to the youthful demographics of the African population [11]. The male frequency was 89%, compared to 11% for females, resulting in a sex ratio of 8.52 (**Table 1**). This is similar to a study conducted in Mali in 2018 by Yambasu EE *et al.*, which found a male predominance of 94.36% among donors, with a sex ratio of 16.73 [12]. This high male frequency was also reported in several studies in Sierra Leone in 2016 by Yambasu EE *et al.* [13]-[15]. According to the World Health Organization, only 28% of blood donations come from women [16]. This male predominance could be due to physiological factors such as menstrual cycles, pregnancy, and breastfeeding, which can restrict women from donating blood [17]. Women generally experience more fear and stress, which may contribute to their low participation in blood donation. The seroprevalence of HIV infection was 5.56% among first-time donors (**Table 1**). This result was higher than a study in Mali by Goita D1 *et al.*, which found 1.90% [8], and lower than a study in Bangui from 2015 - 2019 by Christian Maucler Pamatika *et al.*, which found 7.10% among first-time donors [5]. By 2022, HIV infection will be second only to HBV infection among first-time donors. Additionally, the low rates of HIV marker seroprevalence in various studies indicate improvements in preventive measures related to donor selection and condom use among blood donors [18]. Our study showed a high frequency of first-time donors in the private sector (71.60%), with an HIV infection prevalence of 65.29% ($p < 0.001$). Civil servants accounted for 9.78%, with 13.88% being HIV-positive, showing a significant association ($p = 0.005$). The overall frequency of pupils and students was 10.29%, with a prevalence of 17.47% HIV infection, showing no significant association ($p > 0.05$, **Table 2**). These results differ from a 2018 study in Algeria by Sarah Ayad *et al.*, which found 41.63% in the liberal sector and 5.58% among students [7]. This is lower than the 2018 Bamako study by M. Alamir Ibrahim MAIGA, which showed 21.1% participation by civil servants and 14.9% by pupils and students [19]. A survey by Duboz P. *et al.* showed that blue-collar workers, executives, and higher intellectual professions donated less than intermediate professions [20]. We found a variation in the representativeness of first-time donors' professional backgrounds. The choice of outreach and blood collection sites

could be the reason for this variation. Regarding marital status, the donor population was more likely to be in a common-law union (72.88%), with an HIV prevalence of 77.38% and a significant difference (p = 0.001), followed by bachelors (22.62% with p = 0.01) (**Table 2**). It should be noted that the Free Union population represented first-time donors who did not live with their partners.

HBV seroprevalence in this study was 10.11% among first-time donors (**Table 1**). This prevalence is higher than that reported in the Central African Republic in 2016 by Nambei WS. *et al.*, who recorded 8.89% [6], MY Dicko *et al.*, who found 7.9% [21], the Democratic Republic of Congo, 8.01% [14], and Ségou in 2012 by Kone MC *et al.*, who recorded 5.30% of HBV cases [15]. This low rate could be explained by the one-year study period and the focus on first-time donors. In contrast, a study in CAR showed a high HBV prevalence rate of 17.2% among first-time donors [5]. This high rate may be due to the large sample size and the 5-year duration of their study. HBV prevalence in the private sector was 71.57%, with no significant association (p > 0.05). The overall frequency of singles was 26.75%, and that of the free union population was 72.87%, with a prevalence of HBV contamination of 31.26% and 68.74%, respectively, showing a significant association (p < 0.05) (**Table 2**). No cases of infection were found among the married population. HCV seroprevalence was 0.18% among the primary donor population (**Table 1**). This rate was lower than studies carried out in Nigeria in 2018 by Okoroiwu HU *et al.*, who obtained 3.4% [22], and in Equatorial Guinea in 2015 by Xie DD *et al.*, who found 3.71% [23].

Several studies have shown different infection rates: 1.5% in Kayes, Mali [15]; 1.0% in Sierra Leone [12]; 1.3% in Douala, Cameroon in 2014 by Eboumbou Moukoko CE *et al.* [24]; and 1.5% in Tanzania in 2006 by Matee MI *et al.* [25]. The overall frequency of bachelors was 26.75% among irregular donors declared positive, indicating an HCV prevalence of 29.23% with a significant association (p = 10^−8) (**Table 2**). HCV prevalences among different groups were: Unions libres 70.8%, pupils and students 19.23%, civil servants 20%, private sector workers 50.8%, and unemployed 0%. Statistical tests showed a significant difference between all occupational categories and the hepatitis C virus (p < 0.05) (**Table 2**). We recorded a 4.97% prevalence of syphilis infection in the primary donor population. This was similar to studies in Bangui in 2016, which found a seroprevalence of 4.36% [6], and in Tanzania in 2006 by Matee MI *et al.*, which recorded 4.7% [25]. It is also similar to a study in Burkina Faso in 2009 by Nagalo MB *et al.*, which found 3.96% [26]. In contrast, other studies have shown syphilis is rare among blood donors, with a seroprevalence of 0.038% [20] and 0.8% in Sierra Leone [12]. However, some studies reported a high prevalence of syphilis: 16.73% in Ethiopia in 2016 by Abate M *et al.* [19], 8.1% in Cameroon [24], and 21.51% in Equatorial Guinea [23].

However, there is a residual risk (RR) of virus transmission, primarily linked to donations collected during the serological window before the appearance of biological infection markers in the early phase [5]. The 18 - 35 age group showed a

54.38% (856/1574) frequency for syphilis, with a significant association (p = 0.0002, Table 2). The study showed a high frequency of 23.95% of first-time donors in the 4th arrondissement, Bangui's most densely populated area, home to many dynamic young people. The population in Bangui (1535/1574) showed a significant association with syphilis infection (p = 0.009). During the study period, 6989 irregular donors were recorded. The proportion of co-infections was 10.61% (167/1574) among the 1574 cases of HIV, HBS, HCV, and syphilis infection. The HIV/HBS association was the highest, with 5.40% of cases, followed by HIV/syphilis at 1.84%, HIV/HCV at 1.71%, HBS/HCV at 1.08%, and HBS/syphilis at 0.57% (Table 3). These rates are lower than a study conducted in Bangui from 2015 - 2019 by Christian Maucler Pamatika *et al.* at the CNTS, which found 8.9% for HBV/HIV, 3.4% for HBV/HCV, 2.5% for HBV/syphilis, and 2% for HIV/syphilis [5]. However, they are higher than those reported by several authors in Mali in 2019, such as Bah A *et al.*, who found a frequency of 0.94% for HIV/HBV co-infection and 0.40% for HBV/HCV [27]. The prevalence of HIV/HBV co-infection was zero, as observed by NOUBIAP *et al.* at 1.10% [28]. We found that irregular donors had a four-fold risk of being coinfected with HIV/HBS, with an RR = 4.32. The statistical tests showed a significant association between irregular donors and the different types of co-infections: HIV/HBS, HIV/HCV, HIV/Syphilis, HBS/HCV, and HBS/Syphilis, with $p < 0.05$ (Table 3). The analysis techniques used, donor selection criteria, and prevention methods available to donors differ from one country to another. These parameters could account for differences in the data. No cases of triple infection were recorded during the study period.

7. Conclusion

This study showed a significant presence of HBS antigen, anti-HIV, RPR, and HCV antibodies in irregular donors in CAR. A policy to retain this category of blood donors is necessary to prevent infection by the hepatitis B virus and other Transfusion Transmissible Infections (TTIs) and to ensure transfusion safety. Systematic screening of donors is important to prevent HIV/AIDS and other sexually transmitted infections (STIs). It is essential to better understand and re-sensitize blood donors who have abandoned the practice of blood donation (occasional donors, family donors, first-time donors, non-certified donors) and to refer those who have lost their status due to infection by serological markers.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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